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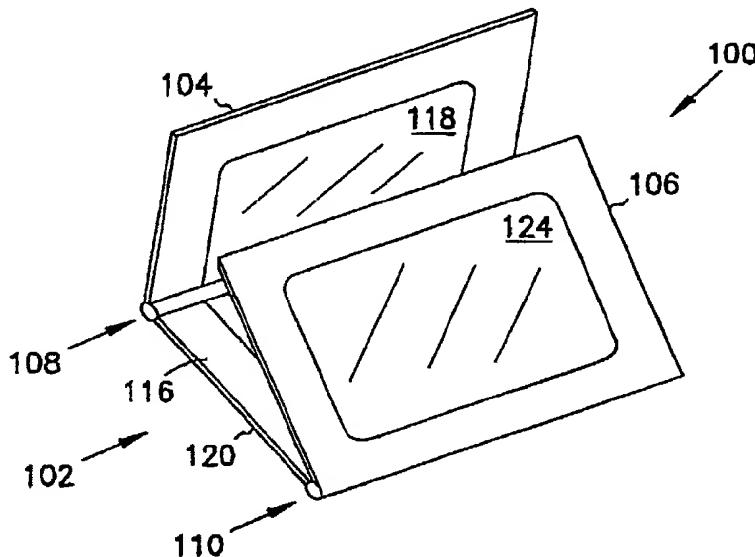
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(54) Title: COMPACTABLE/CONVERTIBLE MODULAR PDA



(57) Abstract: A digital information appliance (100) comprises a housing (102) having at least one foldable panel rotatably (104, 106) attached. A first display region (112) comprises a first segment (114) on a top surface of the housing and a second segment (118) on an inside surface of a panel such that the two segments of the display region are closely adjacent each other when the foldable panel is in an opened position. The appliance also may comprise one or more additional display regions (122) that operate in connection with the first display region in various operating modes of the appliance when the foldable panel is in an opened position and in a closed position. When the appliance has a panel closed

WO 01/53919 A2

and obstructing a portion of the first display region, input and display of information may be handled by another display region, including a second display region on an outside surface of the foldable panel.

## COMPACTABLE/CONVERTIBLE MODULAR PDA

## Field of the Invention

The present invention relates generally to the field of digital information appliances, and more specifically, to a digital information appliance comprised of a central housing having one or more foldable panels rotatably attached.

## Background of the Invention

Digital information appliances, such as personal digital assistants, digital phones, videophones, digital cameras, electronic books and portable information handling systems, are known in the art for being able to store, manipulate and communicate information. In many applications, it is desirable to have the display of information maximized while the appliance is being operated, and minimized when not in use. Current devices do not readily lend themselves to the maximization of the display size for viewing and the minimization of the display and appliance size for storage and standby operation.

## Summary of the Invention

This document describes, among other things, a digital information appliance having a central housing and at least a first foldable panel rotatably mounted on the housing for rotatable or pivotal movement between a closed position covering at least a portion of a top surface of the central housing, and an opened position rotated away from the top surface of the central housing. The appliance comprises a display screen having a first segment mounted on a top surface of the central housing so as to be at least partially covered by the first foldable panel in a closed position, and a second segment mounted on an inside surface of the foldable panel. The first and said second segments of the display screen are constructed and arranged such that they are closely adjacent each other and capable of displaying a substantially continuous image across the first and second segments when the first panel is in the opened position. The appliance also has a control

apparatus, such as a processor or central processing unit, operatively coupled to the first and second segments of the display screen for producing an image across the first and said second segments of the display screen when the panel is in the 5 opened position. The control apparatus is also capable of displaying an image on an uncovered portion of the first segment of the display when the foldable panel is in the closed position.

In an alternative embodiment, the foldable panel may be 10 flipped over and then closed over the central housing such that the first display segment of the central housing is at least partially covered by the foldable panel while the second segment of the foldable panel now faces outward, rather than inward toward the central housing. In this manner, the smaller 15 display region of the second segment of the display panel may be used while the appliance is in the closed position.

This document also describes an alternative embodiment of a digital information appliance having a central housing and a foldable panel rotatably mounted on the housing for pivotal 20 movement between a closed position covering at least a portion of a top surface of the central housing and an opened position. A display screen has a first segment thereof mounted on a top surface of the central housing and a second segment thereof mounted on an inside surface of the first panel. The first and 25 said second segments of the first display screen are constructed and arranged such that they are closely adjacent each other when the first panel is in the opened position. There is also a second display screen mounted on an outside 30 surface of the foldable panel such that the image displaying portion thereof is visible when the foldable panel is in the closed position. There is also control apparatus operatively coupled to the first display screen for producing an image on the first display screen when the first panel is in the opened position. The control apparatus is also operatively coupled to 35 the second display screen for producing an image on the second display screen when the second panel is in the closed position.

It is to be understood that both the foregoing general

description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention claimed. The accompanying drawings, which are incorporated in and constitute part of this specification, 5 illustrate embodiments of the invention and, together with the general description, serve to explain the principles of the invention.

#### Brief Description of the Drawings

In the drawings, like numerals describe substantially 10 similar components throughout the several views.

Fig. 1 is a perspective view of a digital appliance according to the present invention illustrating a first and second panel shown in a partially opened position which is achieved by pivoting each panel on its hinged connections to 15 the central housing, further showing a first foldable display screen and a second display screen mounted on an outside surface of one of the panels;

Fig. 2 is a perspective view of the embodiment of Fig. 1 where the panels are in the fully opened position showing two 20 display panels;

Fig. 3 is a side elevation view of the embodiment of the invention shown in Fig. 1 where the foldable panels completely overlap each other and the top surface of the central housing;

Fig. 4 is a side elevation view of another embodiment of 25 the invention where the foldable panels do not overlap each other;

FIG. 5 is a perspective view of an alternative embodiment of the present invention having a single display screen used to provide display segments 514, 518 and 522;

30 Figs. 6 and 7 are perspective views of a videophone embodiment of the invention in the partially and fully opened positions respectively; and

Fig. 8 is a perspective view of an embodiment of the invention where the hinged connection is in the middle of the 35 panel.

#### Detailed Description of a Preferred Embodiment

In the following detailed description, reference is made

to the accompanying drawings that form a part of the disclosure herein, and in which is shown by way of illustration, specific embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that the embodiments may be combined, or that other embodiments may be utilized and that structural, logical and electrical changes may be made without departing from the spirit and scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims and their equivalents. In the drawings, like numerals describe substantially similar components throughout the several views.

Referring now to FIGS. 1 through 8, a digital information appliance 100 (and 600) is shown. Digital information appliance 100 comprises a central housing 102, sized and shaped so that it may be held by a user in one hand. In the embodiment shown in FIGS. 1 through 3, the appliance may be a personal digital assistant, although a number of other embodiments of the appliance are disclosed herein.

In FIG. 1, the central housing 102 is in communication with a first foldable panel and a second foldable panel, 104 and 106 respectively, which are rotatably or pivotally movable on hinges, 108 and 110 respectively, which are mounted on opposite ends of central housing 102. In the embodiment shown, foldable panel 104, when in the closed position, as shown in FIG. 3, is substantially fully overlapped by foldable panel 106, when they are both in the closed position, although it is understood that in alternative preferred embodiments, panel 104 may be less than fully overlapped by panel 106 when both are in the closed position. In yet another preferred embodiment, such as the one shown in FIG. 4, panel 106 may not overlap panel 104 at all.

As shown more particularly in FIG. 2, a first display screen 112 comprises a first segment 114 mounted on a top surface 116 of central housing 102. A second segment 118 of the display 114 is mounted on an inside surface of panel 104.

In the embodiment shown, display screen 112 is the main display screen for the digital appliance.

When the panel 104 is fully opened, the two segments 114 and 118 of screen 112 cooperate to display a substantially seamless image extending across both segments 114 and 118 to cover substantially the entire image displaying surface portion of display 112. A number of generally available LCD display screens are available that are suitable for use as screen 112. In some embodiments, screen 112 will be a polymer backed LCD that is foldable along hinge 108. In other embodiments screen 112 may alternatively be two separate segments 114 and 118 that are mounted on housing 102 and panel 104 so that their image bearing surfaces substantially abut each other when panel 104 is in the fully opened position.

It is understood that the present invention is intended to cover an appliance having the central housing 102 and a first panel 104 only. However, since it is desirable to have a large display area, a preferred embodiment of the present invention will be discussed with reference to the present illustrations that show an appliance having the central housing 102, as well as a first and a second panel, 104 and 106, respectively.

Furthermore, it is to be understood that the first panel 104 may also be hinged in the center of the panel (as shown in FIG. 8) such that the panel 104 can be flipped over to expose the second segment of the display even when in the closed position. In other words, the foldable panel 104 may be flipped over and then closed over the central housing 102 such that the first display segment 114 of the central housing 102 is at least partially covered by the foldable panel 104 while the second segment 118 of the foldable panel 104 now faces outward, rather than inward toward the central housing 102. In this manner, the smaller display region of the second segment 118 of the display 112 may be used while the appliance 100 is in the closed position.

In some embodiments of the present invention, screen 112 may also have a "touch screen" feature that allows a user to enter information into the system by touching designated portions of the screen in response to the image displayed on

the screen. For example, in the personal digital assistant of FIGS. 1 through 3, the image displayed may facilitate the entry of text information by displaying the image of a keyboard so that the user can form words by selecting characters from the 5 displayed keyboard by tapping screen 112 with a suitable stylus. In other embodiments of the invention, the user may select for display certain information, such as dates from calendars or stored memos from an index of memos by using the stylus to designate desired information from a menu displayed 10 on screen 112.

While the embodiment illustrated in FIGS. 1-3 employs screen 112 to act as a single or unitary display unit, other embodiments of the invention may have operating configurations where the first segment 114 of screen 112 shows one type of 15 information and the second segment 116 of screen 112 may display another type of information than is displayed on segment 114. Segment 114 of screen 112 may even be configured to act as a touch screen control and display unit while segment 116 acts as a display only, and vice versa.

20 In the embodiment shown, central housing 102 also comprises control apparatus 120 that may be contained within it for performing the various functions performed in the digital information appliance. Control apparatus 120 is operatively coupled to the first 114 and second 118 segments of the first 25 display screen 112 to produce a unitary image thereon, whether it is comprised of one folded screen or two closely adjacent separate screens.

30 In configurations of the digital information appliance where screen 112 is also configured to receive information inputs, those signals are processed by the control apparatus. In certain embodiments of the digital information appliance, the control apparatus 120 shuts down the display screen when the first panel is not in the opened position, unless the second segment of the panel 104 is flipped over to be viewed in 35 the closed position.

In the embodiment shown in FIGS. 1-3, second panel 106 has a second display screen 122 mounted on the inside surface thereof so that it is visible to the operator when the second

panel is in the opened position as shown in FIG. 2. In that embodiment, second display screen 122 is a touch screen display configured for operation with the control apparatus 120 to function as the primary data entry unit when the panels are in 5 the opened position. Second display screen 122 and first display screen 112 normally function to display separate image information. As distinguished from folded display screen 112, second display screen 122 is a separate unit from first display screen 112 and the two displays need not be so close to each 10 other so as to have the capability of displaying a substantially seamless image across both display screens.

In FIG. 5 an alternative embodiment of an information appliance is shown where the first and second display screens are either a single screen display folded along both hinge 15 lines 508 and 510 or are two or more closely contiguous individual screen segments 514, 518 and 522 which may all be controlled by control apparatus 520 to seamlessly display a single image across all three display screens covering the central housing and the inside surfaces of both the first 504 and second 506 folding panels.

FIG. 4 shows the digital information appliance in a fully closed position with the first panel 104 and second panel 106 closed over the central housing 102. It can be seen in FIG. 4 that panels 104 and 106 are substantially thinner than central 25 housing 102 because substantially all of the control apparatus 120 is in the central housing 102 and the panels may carry only the display screens 122 and 124 mounted on them.

When the appliance shown in FIG. 1 is fully closed, display and data entry screen 124 is mounted on the outside 30 surface of panel 106 so that is accessible to the user when the accessory is fully folded. Display and data entry screen 124 remains accessible for limited operation of some aspects of the appliance 100 even when it is in the fully closed mode as discussed below. This is an alternative to having the first 35 panel 104 being centrally hinged such that the first panel can be flipped over. With screen 124, there would not be a need to be able to flip a display since 124 would already be viewable from the exterior when the panels are in the closed position.

Because display screen and data entry device 124 is mounted on the outside surface of panel 106, either it or screen segment 118 can be used to review certain information concerning the status and operation of the personal data 5 assistant when first panel 104 is in an opened position while panel 106 is in a closed position.

In some embodiments, data entry screen 124, when both panels 104 and 106 are closed, the information normally presented on second display screen 122 when the panels are 10 opened, is presented on screen 124. In other embodiments, the information presented will be limited so that only critical status or other information is displayed on screen 124 when both panels are in the closed position. In viewing FIG. 3, it is to be understood that panel 106 may be folded closed first, 15 and then panel 104 may be folded over panel 106. This allows for panel 104 to provide protection to screen 124 when the appliance is in the closed position and being stored away.

FIGs. 6 and 7 show a videophone 600 embodiment of the present invention. In the embodiment shown, the videophone 600 20 has an internal video camera 601, which is shown as a part of central housing 102 in which the mechanism of the camera is contained with suitable control apparatus 620 for operating the camera and the display screens 612, 618 and 622.

While an internal video camera is shown in the drawings, 25 an external video camera can be alternatively provided and its image signal provided to the videophone by an infrared port, a USB port or any other suitable coupling arrangement. In operation of the videophone 600, camera 601 provides the control apparatus 620 with an image of the user of the 30 videophone that is then transmitted to the videophone of the party with whom the user is communicating.

When an image of the communicating party is received, control apparatus 620 may typically provide the image to the first display, screens 612 and 618. Typically, information 35 relating to the status and operation of the videophone is provided to the second display screen 622 when both of the foldable panels 604 and 606 are fully opened. In the embodiment shown, second display screen 622 is typically

equipped with a touch sensitive layer for accepting the input of user-supplied information when both foldable panels 604 and 606 are opened.

Typically the information inputted through the touch screen panel of display screen 622 would include dialing information put in by the user to access another phone or videophone. The dialing information applied could include selecting an already stored phone number from a list displayed on first display screens 612 and 618 or a complete phone number applied by the user to the touch screen layer of screen 612. Some of the same information shown and received on the second display screen 622 may, under the control of control apparatus 620, also be displayed and input from the third display screen 624 when the second foldable panel is in the closed position.

When the videophone 600 is not in full operation, first and second panels 604 and 606 may be in the closed position. At this time, the control apparatus 620 provides the image data to third display screen 624, which, because it is located on the external face of the panel, is readily viewed when the videophone 600 is not fully operating and the panels have been folded for more compact operation. The information that might typically be displayed might relate to the condition of the batteries among other things. When an incoming call is directed to the videophone 600, third display screen 624 may cooperate with control apparatus 620 to display the caller ID of the phone originating the call. In the embodiment shown, third video display screen may spend much of the time in a "resting" mode with nothing displayed until the videophone 600 is activated by an incoming call, generation of an internal alarm by the control apparatus to indicate that some scheduled activity is due for action or if the user does something affirmative to at least partially turn videophone 600 on by touching display screen 624 or even by moving videophone 600.

Another embodiment of the invention could be a digital camera combined with personal digital assistant features. Such a digital camera could have an internal camera portion as was the case with the videophone 600 or could operate with a separate camera sensing portion which communicates its

information to the digital information appliance using suitable coupling technology such as standard infra red or other information ports. Without departing from the present invention, the camera could be used for still photographs or

5 video or both.

It is also contemplated that other embodiments of the digital information appliance 100 of the present invention may combine features of one or more of the embodiments specifically illustrated herein. For example, another embodiment of the

10 information appliance could be a combination of a personal digital assistant as shown in FIGs. 1 through 4 and the digital videophone shown in FIGs. 6 and 7. Control apparatus 120 could determine whether, at any particular time the appliance 100 were to be operated as phone or personal digital assistant

15 or, in some cases as both devices simultaneously.

In still other embodiments the digital information appliance could be configured as a game appliance with the first screen used for display of game information and the second display screen to input control and operating

20 information for selecting and playing the game. In the operating mode where the playing of the game is suspended and the panels closed, the control apparatus shuts down the communication of information with the second display screen and enables communication to and from the third display screen.

25 In still further embodiments of the invention the digital appliance can be used as a file or scrapbook for a collection of photographs or for a collection of memoranda or pages of information in a book, for example. In all of those cases the first display screen, because of its relatively larger size

30 would normally be selected as the primary display of the images of the stored information to be viewed while the second and third screens would function respectively for the operation and control of the device in the fully opened and fully operating condition and in the reduced operation condition called for

35 when the first and second panels are in the closed position.

Another embodiment could be a combined personal digital assistant and telephone, which would merely omit the video portion of the videophone shown in FIGs. 6 and 7 in combination

with the personal digital assistant of FIGs. 1-4. Of course another embodiment could be comprised of a compact telephone alone that would operate equivalent to the videophone with the omission of the video feature

5 It is to be understood that the above description is intended to be illustrative, and not restrictive. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended  
10 claims, along with the full scope of equivalents to which such claims are entitled.

## WHAT IS CLAIMED IS:

1. A digital information appliance comprising:
  - a central housing having a control apparatus;
  - 5 a first panel in rotatable communication with said central housing for rotating said first panel between an open position and a closed position relative to said central housing, wherein said first panel covers at least a portion of said central housing when in the closed position;
  - 10 a display region in electrical communication with said control apparatus comprising a first segment and a second segment, said first segment being located on a top surface of said central housing and said second segment being located on a first surface of said first panel, wherein movement of said first panel into the open position places said second segment of said first panel adjacent to said first segment of said central housing such that said control apparatus is capable of presenting a substantially continuous image across said display region's first and said second segments; and
  - 15 said control apparatus being capable of displaying an image upon an outwardly facing second segment of said first panel or an uncovered portion of said first segment of said central housing when said first panel is in a closed position.
- 25 2. The digital information appliance of claim 1 further comprising:
  - a second panel comprising a third segment of said display region in rotatable communication with said central housing for rotating said second panel between an open position and a closed position relative to said central housing, wherein movement of said second panel into the open position places said third segment of said first panel adjacent to said first segment of said central housing such that said control apparatus is capable of presenting a substantially continuous image across said display region's first, second and third segments.
- 35 3. The digital information appliance of claim 2 wherein

5 said first panel is capable of being placed in a closed position covering at least a portion of said first segment of said central housing, and said second panel is capable of being placed in a closed position covering at least a portion of said first panel.

10 4. The digital information appliance of claim 2 wherein said second panel is capable of being placed in a closed position covering at least a portion of said first segment of said central housing, and said first panel is capable of being placed in a closed position covering at least a portion of said second panel.

15 5. The digital information appliance of claim 1 wherein said display region comprises a touch sensitive layer extending across said display region for accepting input.

20 6. The digital information appliance of claim 5 wherein display region comprises a folding liquid crystal display (LCD) screen.

7. The digital information appliance of claim 6 wherein said folding LCD screen is a polymer LCD.

25 8. A digital information appliance comprising:  
a central housing having a control apparatus;  
a first panel in rotatable communication with said central housing for rotating said first panel between an open position and a closed position relative to said central housing, wherein  
30 said first panel covers at least a portion of said central housing when in the closed position;

35 a first display region in electrical communication with said control apparatus comprising a first segment and a second segment, said first segment being located on a top surface of said central housing and said second segment being located on a first surface of said first panel, wherein movement of said first panel into the open position places said second segment of said first panel adjacent to said first segment of said

central housing such that said control apparatus is capable of presenting a substantially continuous image across said display region's first and said second segments;

5 a second display region in electrical communication with said control apparatus comprising a third segment, said third segment being located on a second surface of said first panel, wherein said second surface faces outward when said first panel is in a closed position, and

10 said control apparatus being capable of displaying an image upon said outwardly facing third segment of said first panel when said first panel is in a closed position.

9. The digital information appliance of claim 8 further comprising:

15 a second panel comprising a third segment of said first display region in rotatable communication with said central housing for rotating said second panel between an open position and a closed position relative to said central housing, wherein movement of said second panel into the open position places 20 said third segment of said first panel adjacent to said first segment of said central housing such that said control apparatus is capable of presenting a substantially continuous image across said first display region's first, second and third segments

25

10. The digital information appliance of claim 8 wherein said first and said second display region each comprises a touch sensitive layer extending across said first and said second display region for accepting input.

30

11. The digital information appliance of claim 8 wherein said control apparatus is capable of shutting down said second display region when said first panel is in the opened position.

35

12. The digital information appliance of claim 8 wherein said control apparatus is capable of shutting down said first display region when said first panel is in the closed position.

13. The digital information appliance of claim 9 wherein  
said control apparatus is in electrical communication with said  
second and said third segments and is capable of displaying a  
first image on said second segment when said first panel is in  
5 the opened position, and is capable of displaying a second  
image on said third segment when said first panel is in the  
closed position.

14. The digital information appliance of claim 13 wherein  
10 said first image and said second image are substantially  
similar.

15. The digital information appliance of claim 9 wherein:  
said control apparatus is in electrical communication with  
15 said second segment and said third segment and is capable of  
providing an image to said third segment when said first panel  
is closed and is capable of providing the same image to said  
second segment when said first panel is closed.

20 16. The digital information appliance of claim 8 where  
said first display region is a folding LCD screen.

17. The digital information appliance of claim 16 wherein  
said folding LCD screen is a polymer LCD.

25 18. The digital information appliance of claim 8 wherein  
said digital information appliance is capable of functioning as  
a personal digital assistant.

30 19. The digital information appliance of claim 8 therein  
said digital information appliance is capable of functioning as  
a digital videophone device.

20. The digital information appliance of claim 8 wherein  
35 said digital information appliance is capable of functioning as  
a personal digital assistant and telephone.

21. The digital information appliance of claim 8 wherein

said digital information appliance is capable of functioning as a digital camera.

22. The digital information appliance of claim 8 wherein  
5 the digital information appliance is capable of functioning as a digital game platform.

23. A method of displaying information on a digital information appliance, said digital information appliance comprising a first display region having a first segment on a central housing of said appliance and a second segment on an inside surface of a foldable panel in pivotal communication with said housing, and a second display region on an outside surface of said foldable panel, the method comprising:

15 displaying an image on said first display region when said foldable panel is in an opened position;

suspending display of said image on said first display region when said foldable panel is being moved to a closed position; and

20 displaying said image on said second display region when said foldable panel is in the closed position.

24. The method of displaying information of claim 23 further comprising:

25 dividing said image into a first portion and a second portion wherein said first portion is capable of being presented via said first segment and said second portion is capable of being presented via said second segment; and

30 suspending display of at least said first portion of said image when said foldable panel blocks viewing of at least a portion of said image.

25. The method of displaying information of claim 24, wherein said first portion and said second portion are capable 35 of being combined to form a continuous image across said first display region's first segment and second segment.

26. The method of displaying information of claim 24,

wherein said first portion and said portion are two independent images that are capable of being viewed independently.

1/5

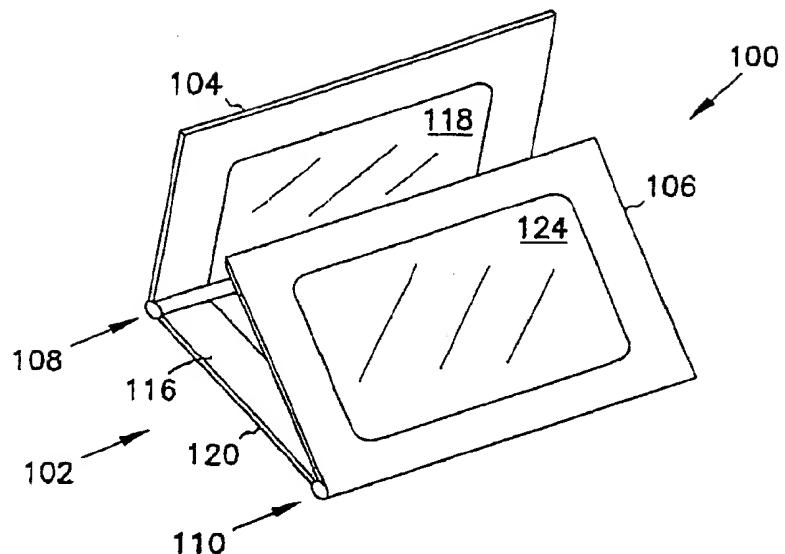


FIG. 1

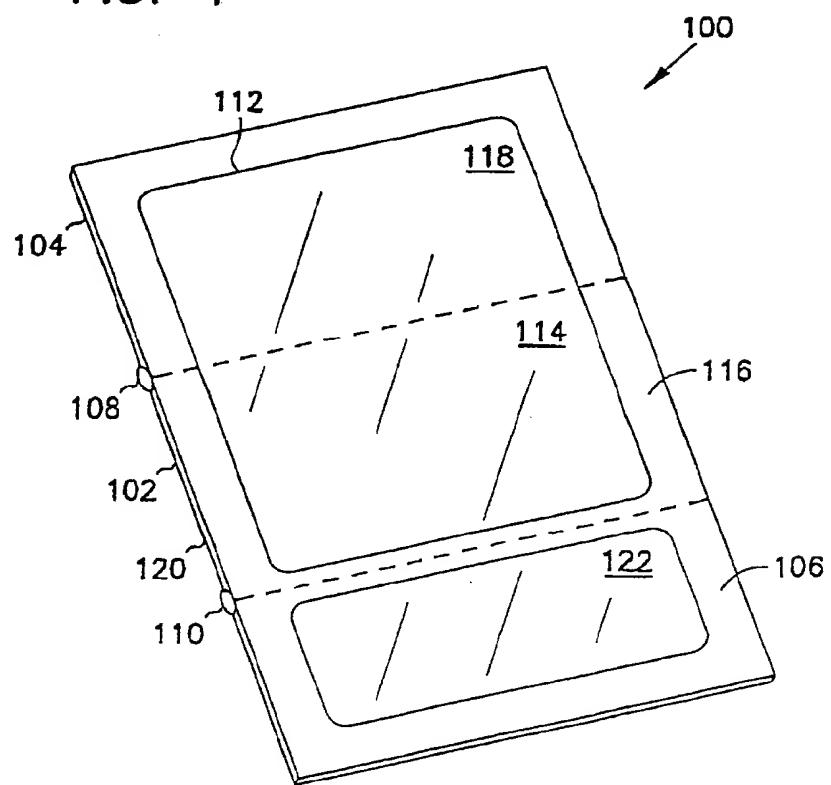


FIG. 2

2/5

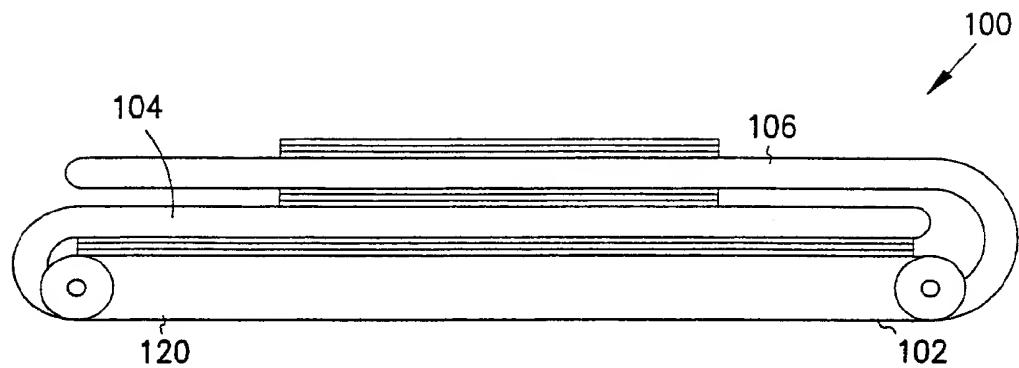


FIG. 3

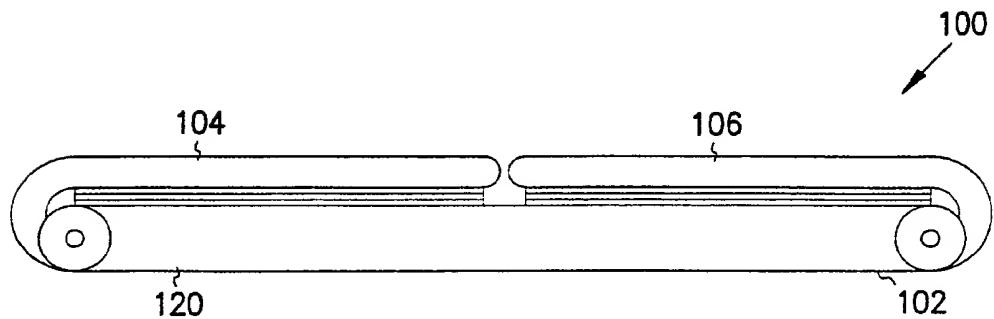


FIG. 4

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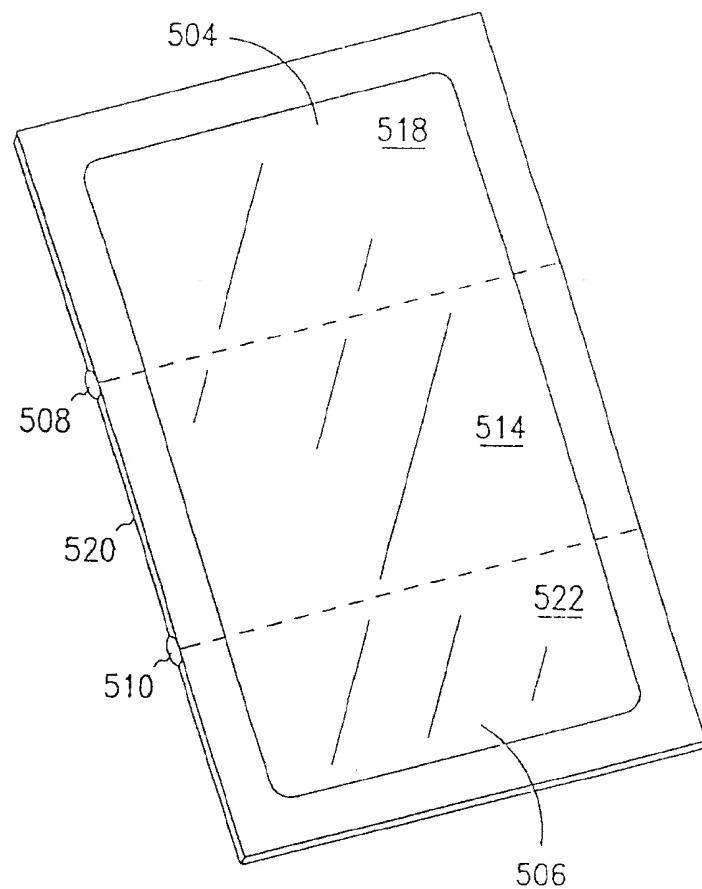
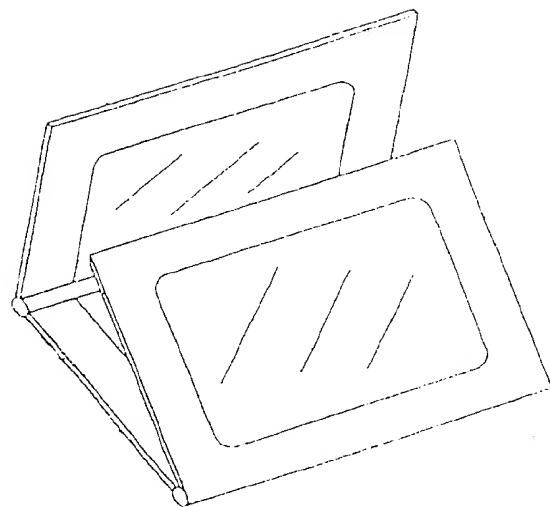


FIG. 5

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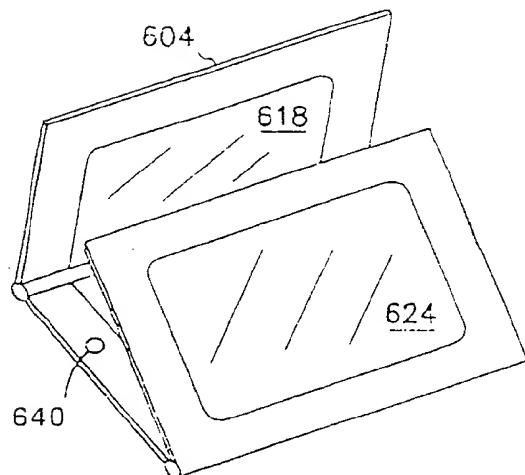


FIG. 6

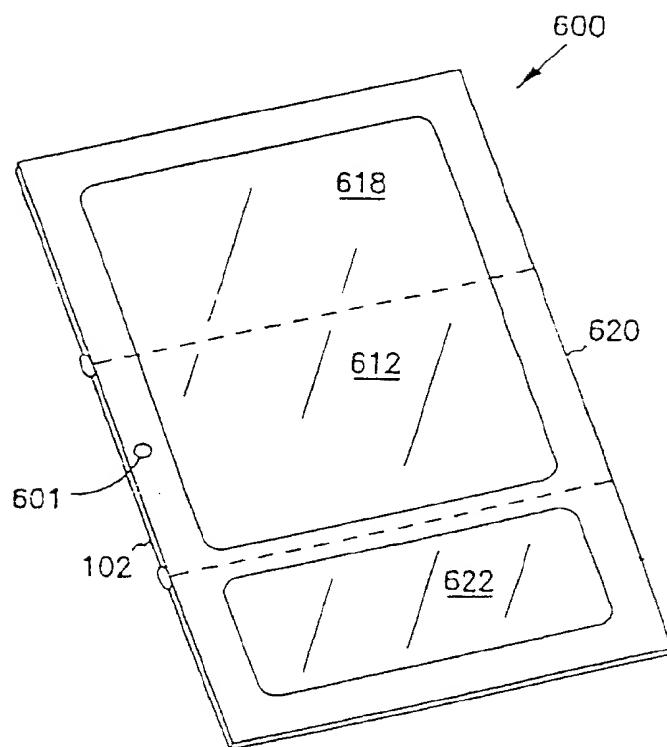


FIG. 7

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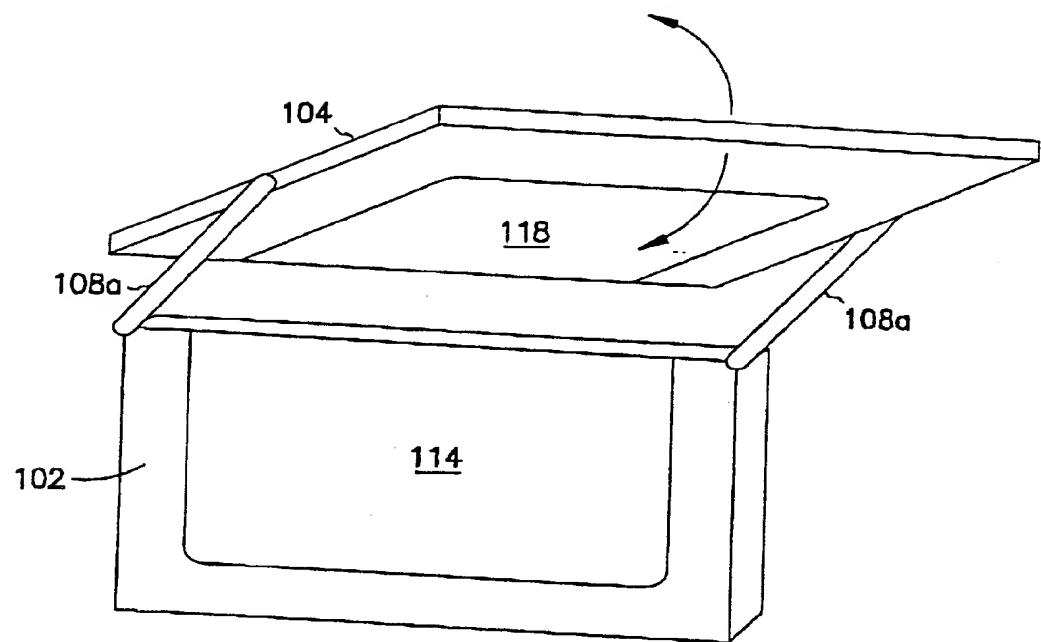


FIG. 8